penetration of a strut. We sought to evaluate whether perceived ease of retrieval of "self-straightening" filters (Bard Denali) justifies changes in clinical practice.
**Material and methods:** Retrospective chart review of all patients in a tertiary care center undergoing successful (n=468) or unsuccessful (n=7) IVC filter removal of a Tulip or Denali filter over a 3-year time period. Study endpoints included removal technique; procedure cost; and procedure, fluoroscopy, and sedation times.
**Results:** When comparing the two devices, successful IVC filter removal did not demonstrate age or gender predilection. Patients with Tulip filters had a longer mean filter dwell time (p=0.039). Tulip filters required slightly longer median fluoroscopy times (difference 0.6 min, p<0.001) and lead to a slight increase in the cost to retrieve (difference $105, p=0.004). Room time and advanced filter removal techniques did not differ between devices. One patient with Denali filter had a technically unsuccessful removal compared with six patients with Tulip filters (p=0.176).
**Conclusion:** Denali filter removal requires slightly less resources than Tulip filter removal; however, our cohort had a longer mean dwell time for successful Tulip filter removal than the cohorts included in previous studies (5.8 months); this is a known complicating factor during filter removal. This data suggests that given the prevalence of advanced filter retrieval techniques, the potential for perceived ease of removal should not determine filter choice.

## P-611

### Geometric changes of the Crux inferior vena cava filter within varying caval diameters

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**Purpose:** To determine how the geometric shape of Crux inferior vena cava (IVC) filters change when deployed within varying IVC diameters.
**Material and methods:** An analytical model predicting dependence of Crux IVC filter length on inferior vena cava diameter was created by assuming the Crux filter takes the shape of two cylindrical helices fixed at their two ends (caudal and cranial), confined to one complete turn, with a fixed arc length of 11.5 cm measured as the undeployed filter in sheath. Two variables account for filter shape changes (axial length and radial diameter).
Fluoroscopic images were obtained of filters deployed in IVC phantoms made from acrylic tubing with inner diameters between 18 and 28 mm. X-ray alignment marks were machined into the phantoms, to ensure X-ray beam was orthogonal to deployed filters. Physiologic conditions were produced by flowing bovine blood heated to 37°C at 0.5 L/min through IVC phantoms during filter deployment.
**Results:** Filters shortened after deployment with increased IVC phantom diameters, shortening up to 60% at the maximum IVC phantom diameter recommended for use by the manufacturer (28 mm). Non-linear regression analysis of Crux filter lengths deployed in bovine blood flowing within IVC phantoms of different diameters fit the analytical model with a root mean square error (RMSE) = 0.42 compared to the linear regression model that produced RMSE = 0.52.
**Conclusion:** Post-deployment filter lengths decreased with increasing IVC phantom diameters, and this dependence is predicted by our analytical model. Predictions of filter length changes may aid filter selection for certain anatomies such as short narrow IVCs.

## P-612

### Caval penetration by retrievable and non-retrievable IVC filter: a retrospective study conducted in 3 community-based hospitals of North Chicago

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**Purpose:** To evaluate the prevalence and patterns of penetration of IVC filters (IVCF)
**Material and methods:** After IRB approval,a retrospective review of CT scans performed on patients with IVCFs implanted between January 2012 and January 2015 was performed. SPSS software was used for statistical analysis.
**Results:** A total of 316 IVCF were implanted, of which 116 subjects had follow-up CT imaging. Among these, 69 (57.8%) had non-retrievable (NR) filters [Greenfield titanium (18), Venatech (18), and Trapease (31)], while 49 (42.2%) had retrievable (R) filters [Optease (7), Bard (1), Celect (33), and Tulip (8)]. Number of follow-up CTs were variable (range 1-5, median 1), while mean follow-up duration was 152.82 days (median 52d). Average age of the sample was 71.02 ± 15.39 years, and the sex ratio (M:F) was 65:51.
Thirty-two (27.6%) subjects demonstrated penetration of at least 1 strut outside the IVC wall with a mean (SD) 2.5 ± 1.8 and with mean (SD) penetration distance of 5.86 ± 1.7 mm. Among patients with penetration, 78.15% (24/32) had (R) filters, which showed statistical significance when compared with (NR) filters ($p < 0.001$). Statistical significance ($p < 0.000$) was noted when penetration was compared to the manufacturer: Celect and Tulip filters showed maximum penetration. Penetration of adjacent organs occurred in 20 (62.5%) subjects (29 IVCF limbs) involving the duodenum, intervertebral disc, aorta, and psoas muscle. Celect filters showed highest rate of organ penetration of 75.8%, where 1 patient had a large post-procedure retroperitoneal hematoma. Only 6 of 49 (12%) retrievable filters were successfully removed.
**Conclusion:** Retrievable filters more often penetrates the IVC wall when compared to non-retrievable filters. IVC wall penetration as a complication of IVCF is asymptomatic; however, organ penetration has a controversial outcome. Delayed/non-retrieval of IVCF increases risks for penetration and other complications.

## P-613

### Retrievable inferior vena cava filters for pulmonary embolism prevention: long-term clinical and CT follow-up after retrieval

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**Purpose:** To study long-term adverse events, complications and anatomical modifications after the bearing and retrieval of inferior vena cava filters (IVCF) for pulmonary embolism (PE) prevention.
**Material and methods:** This retrospective study included 158 IVCF placed from April 2007 to January 2014 with intention of retrieval. All patients were telephonically located and scheduled for IR inquiry. They were asked about symptoms related to recurrent PE, DVT and postphlebitic syndrome. An abdominal CT was performed in patients who gave their consent to evaluate IVC alterations. We recorded any adverse event observed during implantation, dwell time, recovery, 1-year follow-up and the current inquiry.
**Results:** Of 158 patients, 4 could not be located, 1 refused inquiry, and 15 had died (4 pulmonary embolism and 11 non-PE related cause). Of the 138 patients (76 male, 62 female), 125 of 138 filters were recovered at first attempt. Nine filters were impossible

to retrieve (tilting and inclusion of the hook in the wall). Main indications for filter placement were DVT and massive/submassive PE (49.10%), PE and acute bleeding (21.24%) and recurrent PE (16.9%). Two types of filters were used: Gunther Tulip (63.40%) and Celect (36.60%). Most minor complications appeared in the pre-retrieval CT (11 tilting; 14 apparent penetration > 3 mm, 3 intrafilter thrombus). Mean dwell time was 98.32 days (range 30-2160). Mean follow-up was 51.37 (range 35-79).
**Conclusion:** The deployment and recovery of GT and Celect filters for prophylaxis of PE is a safe procedure. Recovery is simple and achieved in most cases. A well-indicated retrieval does not increase the number of cases with DVT or PE.

## P-614

### The role that an IR department plays in association with PE mortality

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**Purpose:** To determine the role that an interventional radiology (IR) department plays in the diagnosis and treatment of acute pulmonary embolism (PE) and its correlation to mortality in a 5-year retrospective study in a single specialised centre.
**Material and methods:** From 2010 to 2014, 722 patients were diagnosed with PE. All relevant patient data were gathered using electronic medical records, analysing the medical history, PE diagnostic method and treatment, dividing the patients in two groups, patients who underwent angiographic diagnosis and treatment (direct and mechanical thrombolysis, with/without IVCF placement) and patients treated with only anticoagulant therapy. All the data were statistically compared between alive and deceased patients, as a case-control study, calculating the risk and protective factors.
**Results:** Of the 722, 610 were alive and 112 dead. Mean hospital stay before death was 9.13±10.39 days. Neoplastic history was the main risk factor for mortality (OR 1.9; 99% CI 1.07-3.49). A history of DVT (OR 0.31; 99% IC, 0.13-0.76) or a previous PE (OR 0.005; 99% IC, 0.001-0.02) were protecting factors, probably due to a quicker diagnosis. Referral to the IR department for angiography and treatment prevented mortality in PE (OR 0.29; 99% CI 0.09-0.88), meaning a higher possibility of survival (1.2-10.6% higher) for patients that underwent IR treatment. Filter placement did not have influence on the final outcome.
**Conclusion:** IR plays an important role in the diagnosis and treatment of PE patients, reducing about 72% of mortality risk in patients who were referred to the IR unit compared to those who stayed in the ICU.

## P-615

### Device-specific complication rates in retrievable inferior vena cava filters: a systematic review and meta-analysis

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**Purpose:** Despite the rapid growth in placement of retrievable inferior vena cava filters (rIVCF), accurate estimates of complication rates of these devices are lacking. Utilizing extracted data, we aimed to estimate device-specific complication rates and, in this respect, identify differences between commonly encountered rIVCF.
**Material and methods:** The MEDLINE, CENTRAL, and ClinicalTrials.gov databases were searched for publications and unpublished trials describing complications in rIVCF that included clinical and imaging follow-up. Data regarding filter fracture, migration, filter thrombosis, and lower extremity deep venous thrombosis (DVT) were pooled using a random-effects model. Serial pairwise comparisons were performed and corrected using the Holm-Bonferroni method. Statistical significance was accepted at $p<0.05$.
**Results:** Fifty-seven studies examining 7199 filters (9 devices: Crux, Option, OptEase, Gunther Tulip, Celect, ALN, Denali, Recovery, and G2) were analyzed. Recovery filters fractured most frequently (7.8%, 95% CI 4.7-12.6; $p<0.01$); Celect filters penetrated the caval wall most frequently (37.3%, 95% CI 17.6-62.3; $p<0.01$); G2 filters migrated most frequently (13.3%, 95% CI 6.1-26.6; $p<0.05$); and Option and Denali filters were associated with recurrent DVT more frequently (12.1%, 95% CI 5.2-25.8; $p<0.05$ and 13%, 95% CI 8.3-18.7; $p<0.05$) than other devices. No difference in DVT was observed between Option and Denali devices ($p=1$). The rates of filter thrombus precluding retrieval were not significantly different among the devices.
**Conclusion:** There are significant differences in the types of complications encountered most frequently with specific rIVCFs. Establishment of device-specific complication profiles fosters an individualized approach to device utilization and retrieval planning; such information is crucial in preventing adverse events and improving patient outcomes.

## P-616

### Endovascular treatment of iliofemoral deep vein thrombosis in pregnancy by using ultrasound-guided percutaneous aspiration thrombectomy

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**Purpose:** The purpose of this article was to describe percutaneous aspiration thrombectomy under ultrasound guidance in pregnant patients with iliofemoral deep vein thrombosis.
**Material and methods:** Nine consecutive pregnant patients with acute and subacute iliofemoral deep vein thrombosis underwent percutaneous aspiration thrombectomy under ultrasound guidance. Aspiration thrombectomy by using large-bore guiding catheters was performed to achieve thrombus removal and uninterrupted venous flow on color Doppler ultrasonography. Balloon venoplasty or Fogarty balloon embolectomy was used, if needed. The treatment was considered successful if there was adequate venous patency and symptomatic relief.
**Results:** Complete or significant thrombus removal and uninterrupted venous flow were achieved in all patients at the first intervention. Two patients (22.2%) had a recurrence of thrombosis in the first post-intervention week; one of them required a second intervention, and the other patient who had high levels of inflammatory markers was not subjected to further intervention. Two patients who had resistance to the advancement of the guiding catheter were treated with balloon venoplasty. The Fogarty balloon embolectomy catheter was used in one patient to remove ball-like subacute thrombus. Complete leg pain relief was rapidly achieved in 8 patients (88.8%), but minimal swelling remained around the ankle. No procedure-related complications or clinically detectable pulmonary embolism were observed during or after the intervention.
**Conclusion:** Endovascular treatment with ultrasound-guided percutaneous aspiration thrombectomy can be routinely used as a safe and effective way to remove thrombus from deep veins in pregnant women with acute and subacute iliofemoral deep vein thrombosis.